NONDESTRUCTIVE PAVEMENT EVALUATION OF STEWART INTERNATIONAL AIRPORT'S RUNWAY 9-27

By: Thomas M. Lombardi, Michael A. Frabizzio and Kaz Tabrizi
Advanced Infrastructure Design, Inc.
1 Crossroads Drive
Hamilton, NJ 08691

INTRODUCTION

- Case-Study on use of NDT survey on Stewart International Airport (SWF) Runway 9-27
- Co-Authors (Mike & Kaz)
- Selection Committee

INTRODUCTION

- Knowledge of existing structure and condition is critical to pavement design
- Airside pavements present challenge for data collection
  - Limited time windows
  - Critical nature of results & runway integrity
- NDT pavement evaluations are considered an efficient and cost-effective solution
- SWF Runway 9-27 in October 2011

OVERVIEW OF THE PROJECT

- SWF located in Newburgh & New Windsor, New York (~1 hr 40min north of NYC)
- PANYNJ jurisdiction
- Runway 9-27
  - 150’ wide (plus 30’ shoulders)
  - 12,000’ long
  - Receives 47,666 operations annually
  - Airplane Design Group D-VI
  - Asphalt surface – containing both flexible and composite pavements

OVERVIEW OF THE PROJECT

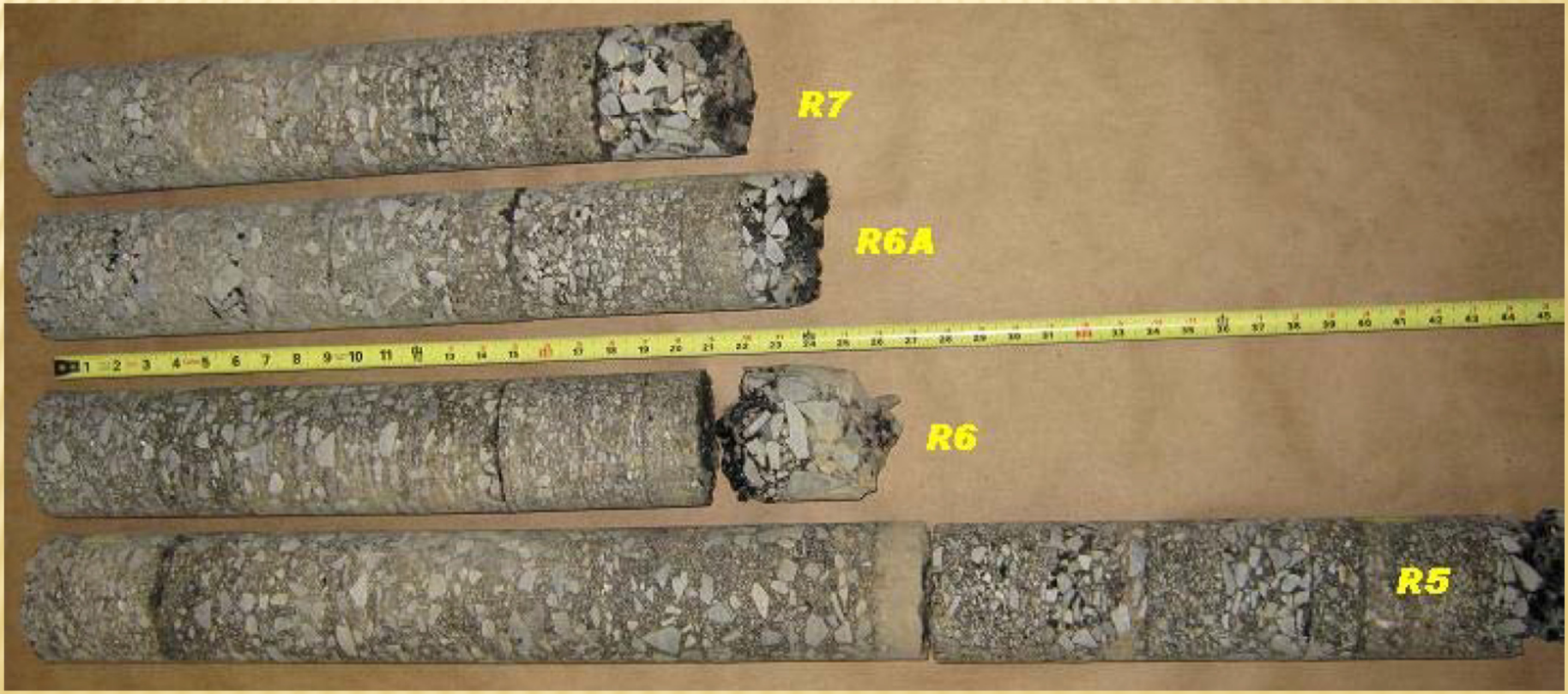
- Owners purpose
  - Rehabilitation Project
    - Resurfacing & update geometrics
- Why NDT?
  - Highly variable core results – 11” to 43” of Asphalt
    - Concerned over reliability of pavement design
  - Crown conversion to meet current standards
    - Concerns over cut section at outer edges of runway due to new geometrics
      - Determine limits of required reconstruction

OVERVIEW OF THE PROJECT

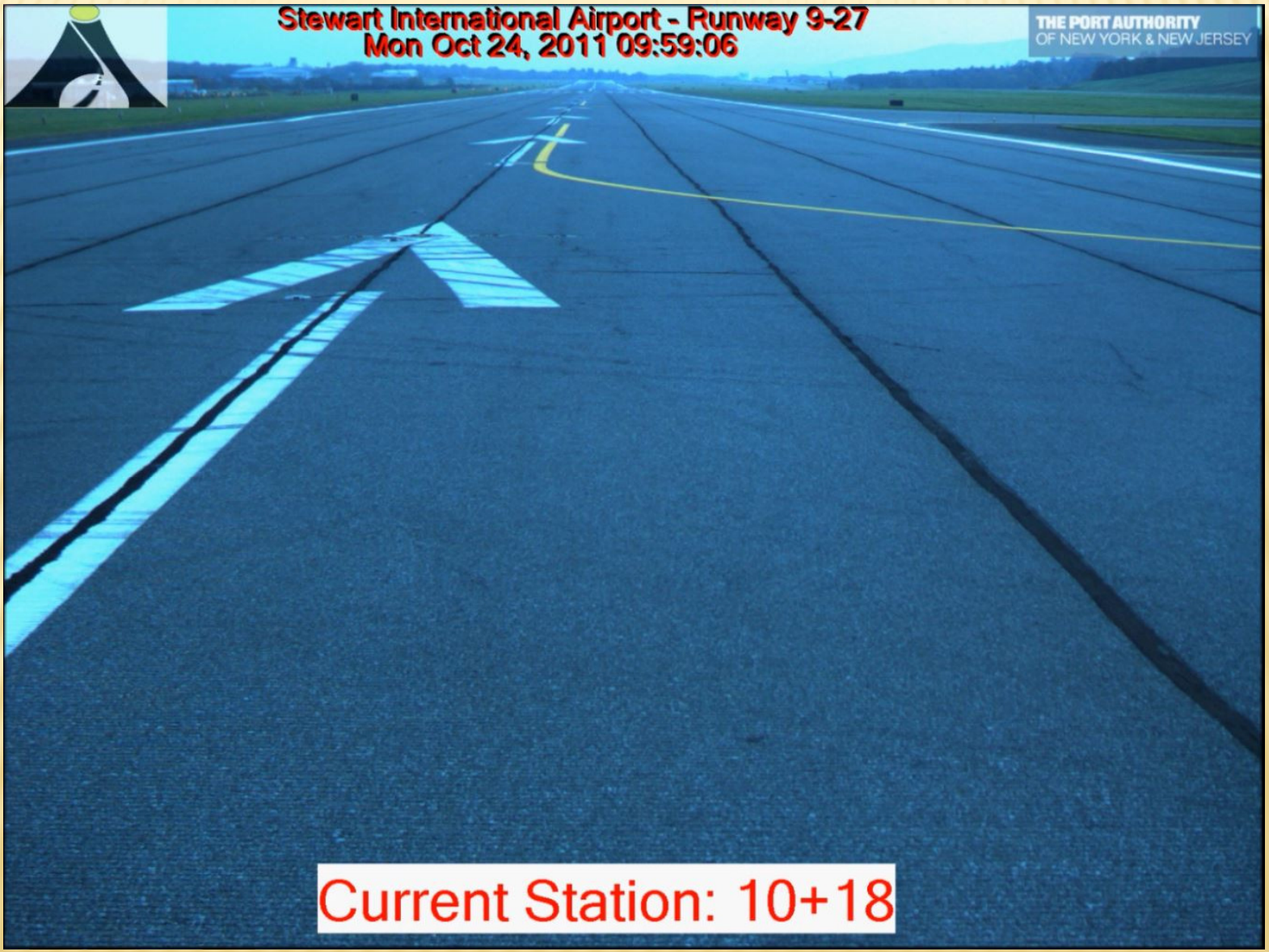
- NDT Program
  - Performed in October 2011
    - 7 nights & 1 day
  - Review Existing Documents
  - Video Collection
  - Ground Penetrating Radar (GPR) testing & analysis
  - Inertial Profiler testing
  - Heavy Weight Deflectometer (HWD) testing & analysis
  - Video/Data Integration software package

NONDESTRUCTIVE TESTING PROGRAM: Review Existing Documents

- Core Information, As-Built plans, Boring Logs
  - R5 = 43” of AC, at Sta. 88+75



NONDESTRUCTIVE TESTING PROGRAM: Collected Video



NONDESTRUCTIVE TESTING PROGRAM: Ground Penetrating Radar (GPR) testing

NONDESTRUCTIVE TESTING PROGRAM: Ground Penetrating Radar (GPR) testing

- Offsets of 10, 20 & 69 ft. (left & right) of centerline to match HWD testing and centerline of shoulders
  - This provided best possible information for HWD backcalculation
- In accordance with
  - FAA AC 150/5370-11A
  - ASTM D 4748-06

Variation in AC Layer Thickness

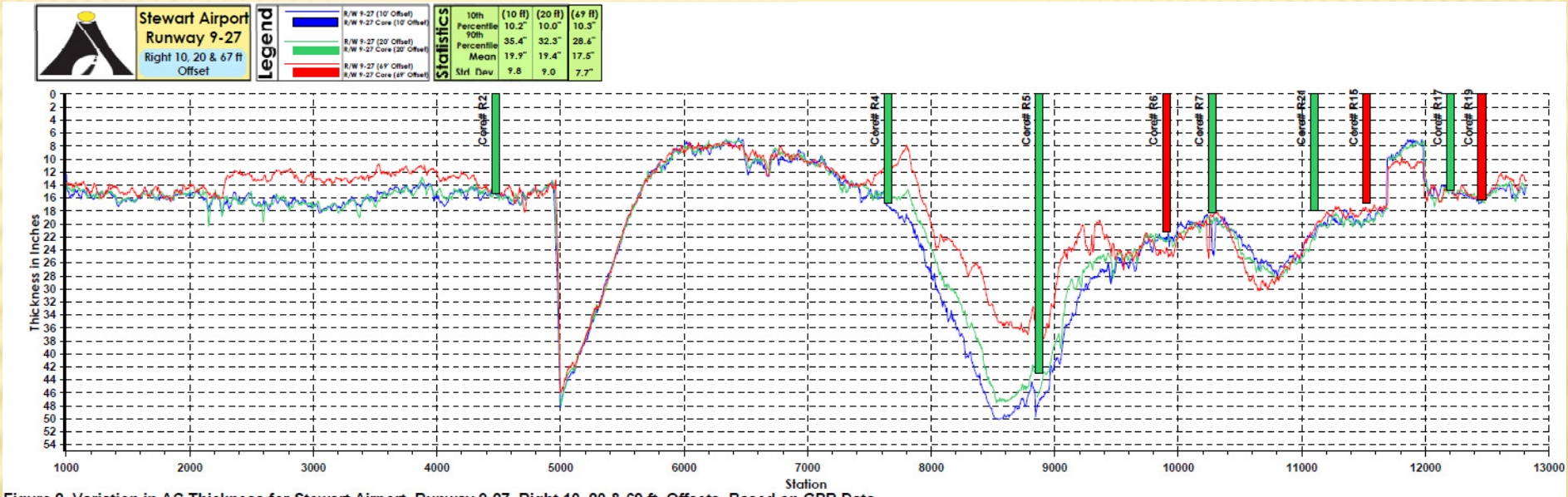


Figure 2. Variation in AC Thickness for Stewart Airport, Runway 9-27, Right 10, 20 & 69 ft. Offsets, Based on GPR Data

Variation in AC Surface & Bottom Elevation

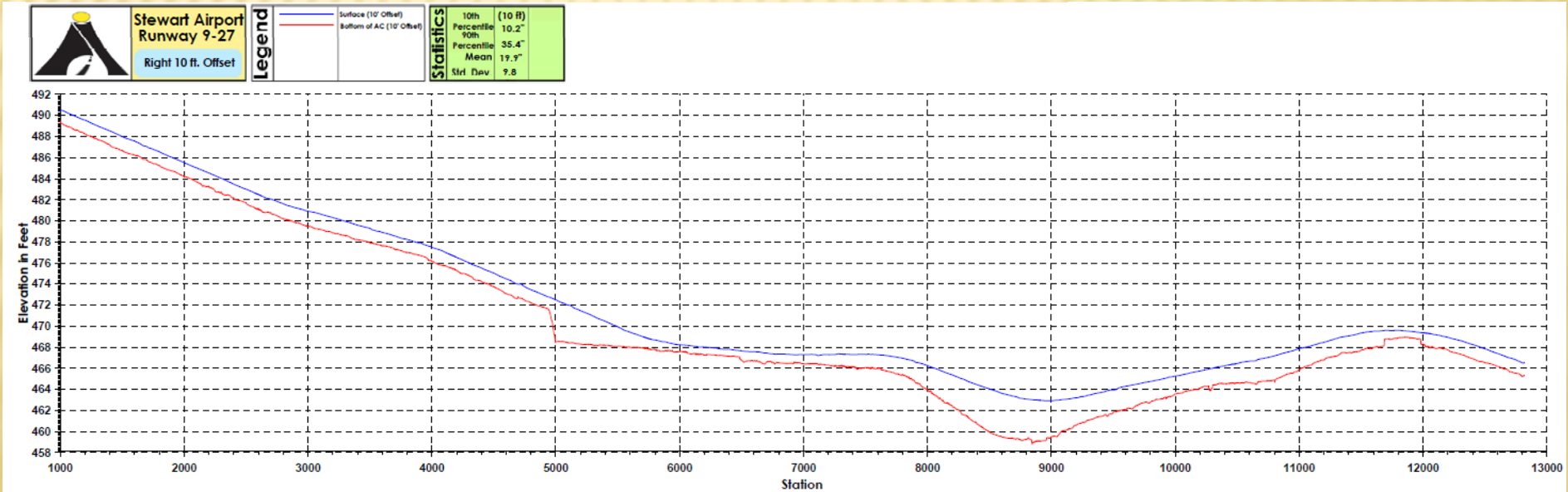


Figure 6. Variation in AC Surface & Bottom Elevation for Stewart Airport, Runway 9-27, Right 10 ft. Offset, Based on GPR Data

NONDESTRUCTIVE TESTING PROGRAM: Inertial Profiler testing

- Full-size Class 1 (ASTM E950) profiler
- Collected on Centerline and at 17.5 ft. offsets left & right of the centerline
  - Based on Airplane Design Group D-VI and guidelines in FAA AC 150/5380-9.
- Used to evaluate the ride quality for PI, RSE and IRI.
  - FHWA's *ProVAL* software was utilized to perform analysis

NONDESTRUCTIVE TESTING PROGRAM: Heavy Weight Deflectometer (HWD) testing

NONDESTRUCTIVE TESTING PROGRAM: Heavy Weight Deflectometer (HWD) testing

- In accordance with FAA AC 150/5370-11A, ASTM D4694-96(03), and ASTM D4695-03
- Testing Scheme
  - Flexible pavement
    - 10’ offsets – 100’
    - 20’ offsets – 150’
    - 69’ offsets – 300’
  - Composite pavement “Center”
    - 10’ offsets – 100’
    - 30’ offsets – 100’
    - 69’ offsets – 200’
  - No joint testing due to lack of visible reflection cracking
  - 1 seating drop of 24.0 kips & 3 loading drops of 18.5, 24.0 and 31.0 kips

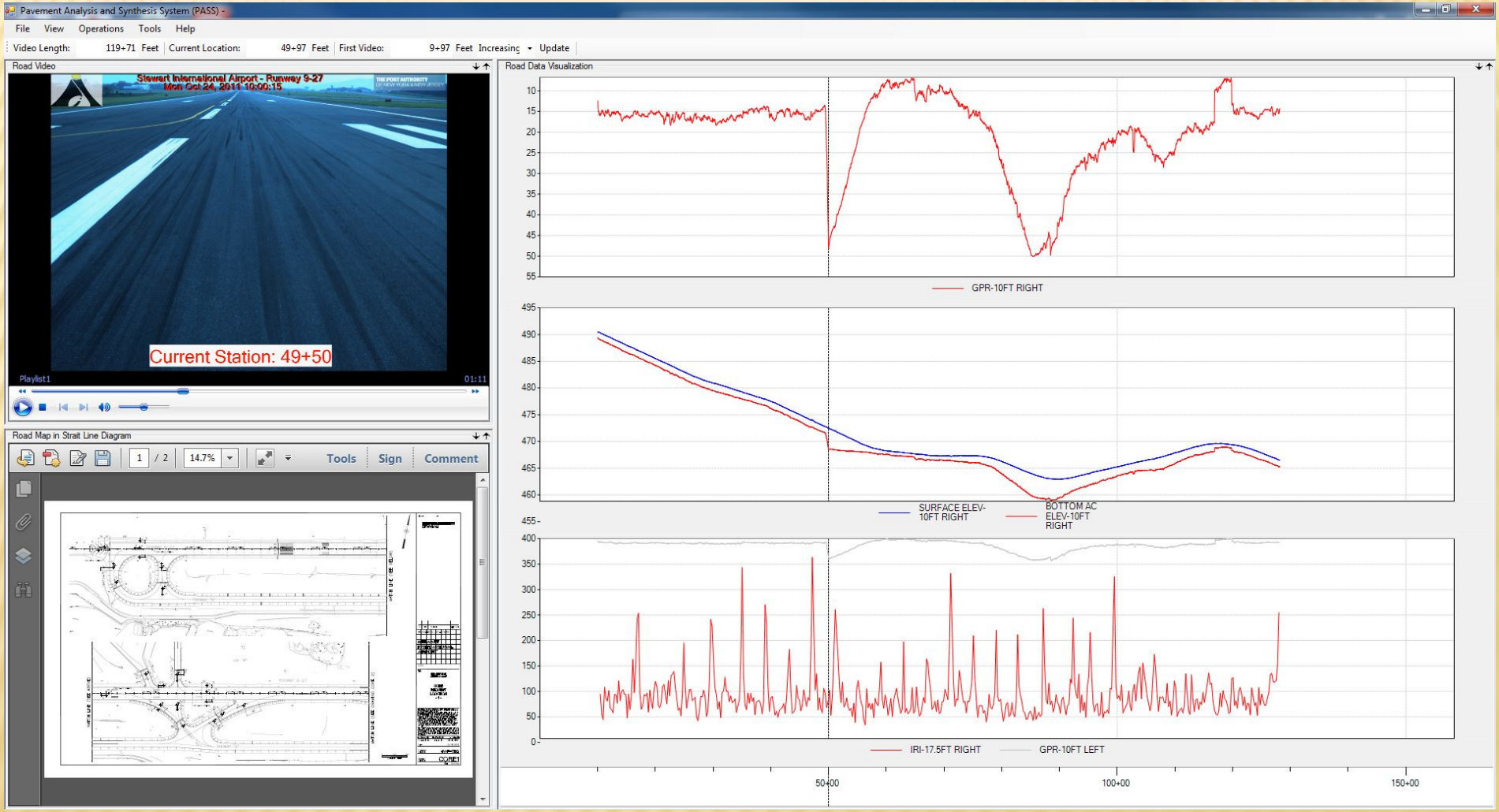
NONDESTRUCTIVE TESTING PROGRAM: Heavy Weight Deflectometer (HWD) testing

- Backcalculation Analysis
  - Allowed for determination of the various pavement layer moduli including AC, PCC, base, subbase and subgrade layers
  - In accordance with FAA AC 150/5370-11A and ASTM D 5858-96(03)
  - TTI'S software program *Modulus* was used

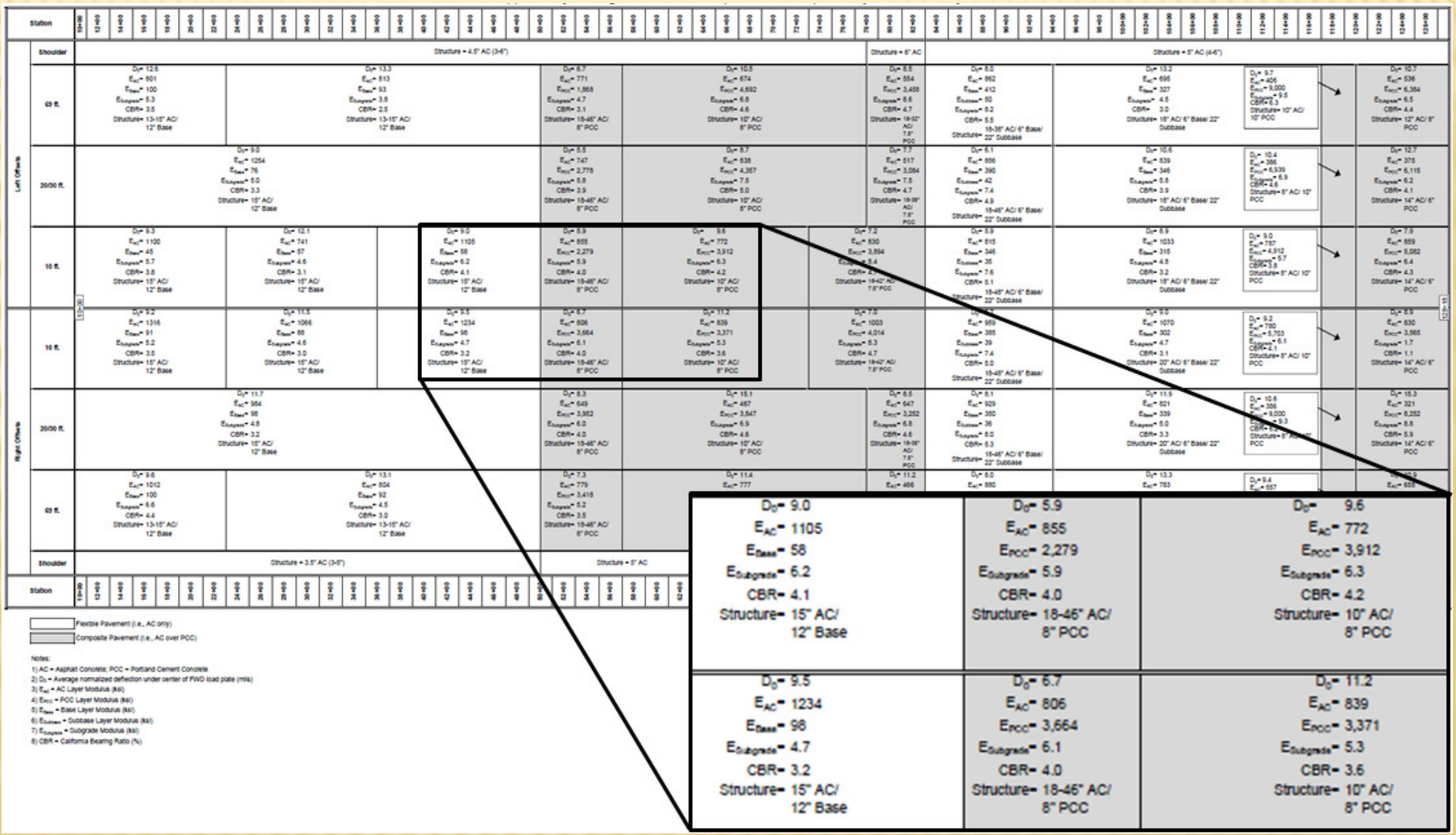
NONDESTRUCTIVE TESTING PROGRAM: Video/Data Integration Software

- NDT/E results for Runway 9/27 were presented for visualization
- Enables simultaneous viewing of video and pavement data by location
- Software package was developed by AID

NONDESTRUCTIVE TESTING PROGRAM: Video/Data Integration Software



OVERALL PAVEMENT CONDITION ASSESSMENT: Sectionalization – Table 1 (Structure & Moduli)

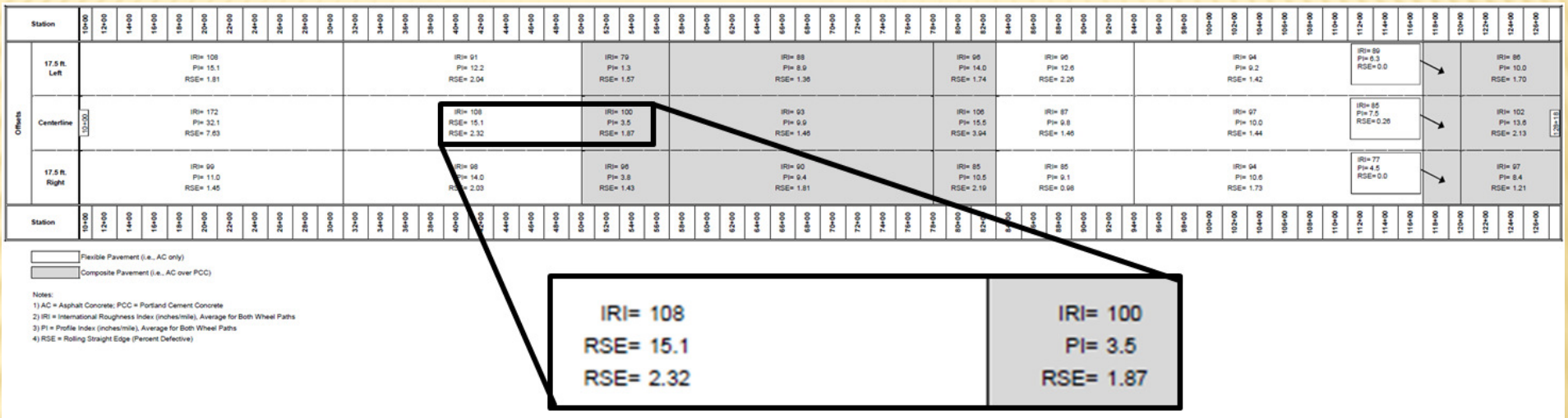


D_0= 9.0 E_{AC}= 1105 E_{Base}= 58 $E_{Subgrade}$= 6.2 CBR= 4.1 Structure= 15" AC/ 12" Base	D_0= 5.9 E_{AC}= 855 E_{PCC}= 2,279 $E_{Subgrade}$= 5.9 CBR= 4.0 Structure= 18-46" AC/ 8" PCC	D_0= 9.6 E_{AC}= 772 E_{PCC}= 3,912 $E_{Subgrade}$= 6.3 CBR= 4.2 Structure= 10" AC/ 8" PCC
D_0= 9.5 E_{AC}= 1234 E_{Base}= 98 $E_{Subgrade}$= 4.7 CBR= 3.2 Structure= 15" AC/ 12" Base	D_0= 6.7 E_{AC}= 806 E_{PCC}= 3,664 $E_{Subgrade}$= 6.1 CBR= 4.0 Structure= 18-46" AC/ 8" PCC	D_0= 11.2 E_{AC}= 839 E_{PCC}= 3,371 $E_{Subgrade}$= 5.3 CBR= 3.6 Structure= 10" AC/ 8" PCC

OVERALL PAVEMENT CONDITION ASSESSMENT: Sectionalization – Table 1 (Structure & Moduli)

- Flexible pavement structure
  - Generally 15-20” of AC (isolated sections up to 43”)
    - Modulus of 600 to 1000 ksi
  - Stiff base layer discovered ~3,400’ stretch consisting of 3-4” “Plant Mix” over 3-4” of “Penetrated Stone”
- Composite pavement structure
  - Generally 8-14” AC overlay (isolated sections up to 43”)
    - Modulus of 600 to 1000 ksi
  - PCC slabs in three segments of 8”, 10” and 6” thickness, respectively
    - Modulus ranged from 2,500 to 4,500 ksi
- Shoulders consisted of 2-6” of AC, except at their junction with taxiways
- Subgrade
  - Modulus of 4,500 to 7,500 psi
  - Correlates to a CBR of 3 to 5%
  - Consists of Silt with varying amounts of sand and gravel
  - Boring logs also indicated shale bedrock at a depth of ~6-8’

OVERALL PAVEMENT CONDITION ASSESSMENT: Sectionalization – Table 2 (Ride Quality)



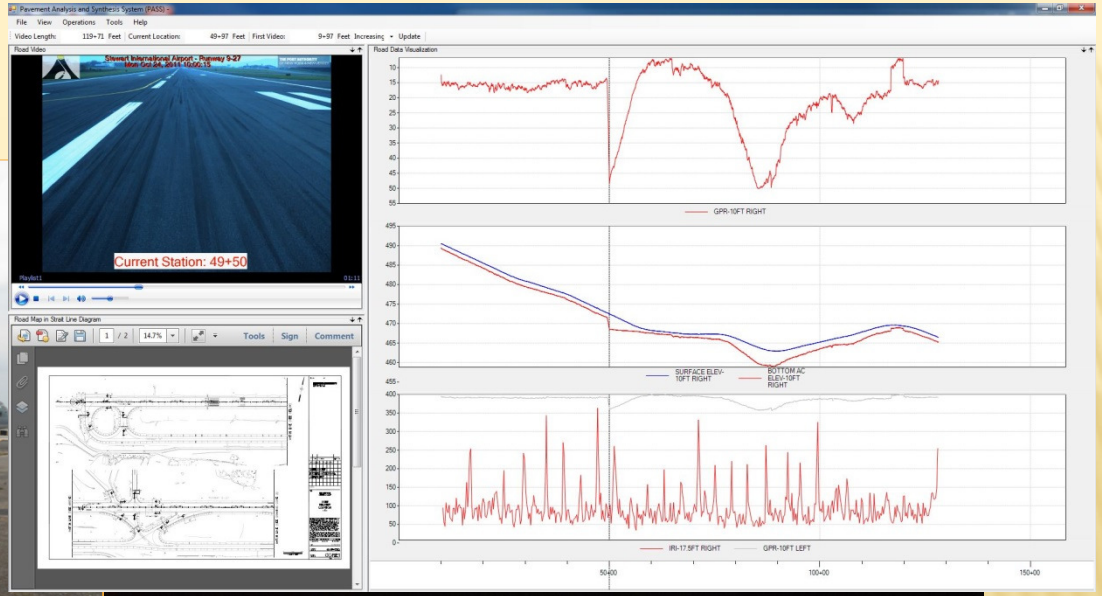
- PI & RSE indicators of localized roughness
  - Fairly smooth for an existing pavement (PI ≤ 15 in/mi, RSE ≤ 2%)
  - Only 1 location with a large amount of roughness (PI = 32.1 in/mi, RSE = 7.63%)
    - review of visualization software showed it was due to runway lighting
- IRI as an additional comparative indicator of overall roughness
- Generally between 80 to 110 in/mi

APPLICATION OF NDT DATA TO DESIGN

- Great deal of detailed and useful data in short period of time
- At Stewart Airport (Client Feedback)
  - Elevation profile of bottom of AC layer allowed for the modeling of the AC layer in *AutoCAD Civil 3D*
    - Higher confidence in design
    - More accurate construction quantities

APPLICATION OF NDT DATA TO DESIGN

- General advantages
  - Detailed information allows for identification of unique conditions (layer thickness, lower quality of degraded materials, subgrade issues, bumps/roughness)
  - Provides the opportunity to create a more reliable and customized design as needed, as opposed to one treatment fits all approach.
  - Provides all pavement structure information required to design in FAA's *FAARFIELD* software.



QUESTIONS ????

Thank You for your attention and patience!